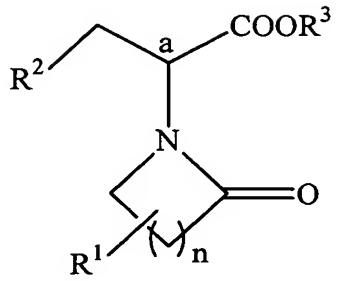
What is claimed is:

1. A compound having the formula VII



VII

wherein R^1, R^2, and R^3 are, independently, hydrogen, a substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl group; a substituted or unsubstituted C_3 to C_8 cycloalkyl group; a substituted or unsubstituted C_6 to C_{20} aryl group; or substituted or unsubstituted C_4 to C_{20} heteroaryl group having at least one heteroatom,

n is from 0 to 5, and

the stereochemistry at carbon a is substantially R or S.

2. The compound of Claim 1, wherein the stereochemistry at carbon a is substantially S.

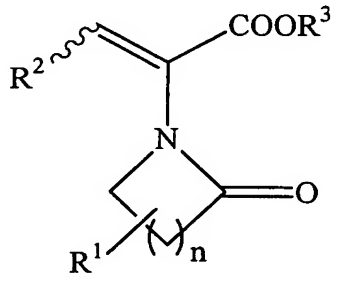
3. The compound of Claim 1, wherein the heteroatom of the heteroaryl group is oxygen, sulfur, or nitrogen, and the substituent on the substituted alkyl, aryl, or heteroaryl group comprises alkyl, aryl, hydroxy, alkoxy, fluoro, chloro, bromo, iodo, nitro, cyano, or an ester.

4. The compound of Claim 1, wherein R^2 and R^3 are independently selected from methyl or ethyl.

5. The compound of Claim 2, wherein R^1 is hydrogen, R^2 is methyl, R^3 is

methyl or ethyl, and n is 2.

6. A method for producing the compound of Claim 1, comprising hydrogenating an enamide having the formula VI



VI

wherein R^1, R^2, R^3, and n are as set forth in Claim 1,

with hydrogen in the presence of a catalyst comprised of a chiral ligand/metal complex to asymmetrically hydrogenate the carbon-carbon double bond of the enamide.

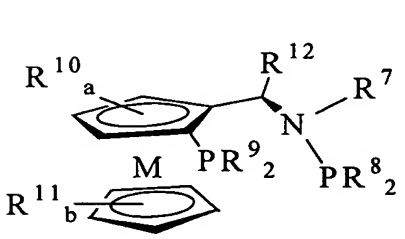
7. The method of Claim 6, wherein the chiral ligand of the chiral ligand/metal complex comprises a phosphine or a bis-phosphine compound and the metal of the chiral ligand/metal complex comprises rhodium, ruthenium, or iridium.

8. The method of Claim 6, wherein the chiral ligand of the chiral ligand/metal complex comprises a phosphine or a bis-phosphine compound and the metal of the chiral ligand/metal complex comprises rhodium.

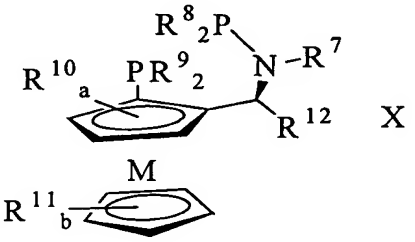
9. The method of Claim 6, wherein the chiral ligand of the chiral ligand/metal complex comprises a substantially enantiomerically pure bis-phosphine compound comprising a substantially enantiomerically pure chiral backbone linking two phosphine residues, wherein one of the phosphine residues has three phosphorus-carbon bonds and the other phosphine residue has two

phosphorus-carbon bonds and one phosphorus-nitrogen bond wherein the nitrogen is part of the chiral backbone.

10. The method of Claim 6, wherein the chiral ligand of the chiral ligand/metal complex comprises a compound having the formula IX or X



IX



X

where R^7, R^8, R^9, R^{10}, R^{11}, and R^{12} are, independently, hydrogen, substituted or unsubstituted branched or straight chain C_1 to C_{20} alkyl, substituted or unsubstituted C_3 to C_8 cycloalkyl, substituted or unsubstituted C_6 to C_{20} aryl, and substituted or unsubstituted C_4 to C_{20} heteroaryl, where the heteroatoms are chosen from sulfur, nitrogen, or oxygen, provided R^{12} is not hydrogen;

a is from 0 and 3;

b is from 0 and 5; and

M is a Group IV to Group VIII metal.

11. The method of Claim 10, wherein M comprises iron, ruthenium, or osmium.

12. The method of Claim 10, wherein a and b are 0, R^7 and R^{12} are methyl, R^8 and R^9 are phenyl, and M is iron.

13. The method of Claim 6, wherein the chiral ligand of the chiral ligand/metal complex comprises the substantially pure enantiomer or diastereomer of 2,3-*O*-isopropylidene-2,3-dihydroxy-1,4-*bis*(diphenylphosphino)butane; 2,2'-

bis(diphenylphosphino)-1,1'-binaphthyl; 1,2-*bis*-2,5-dialkylphospholano(benzene); 1,2-*bis*-2,5-dialkylphospholano(ethane); 2,3-*bis*-(diphenylphosphino)butane; or 2-diphenylphosphinomethyl-4-diphenylphophino-1-*t*-butoxycarbonylpyrrolidine.

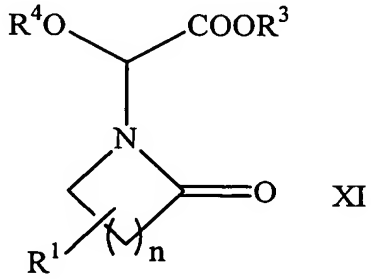
14. The method of Claim 6, wherein the metal of the chiral ligand/metal complex is from 0.0005 to 0.5 equivalents per 1.0 equivalent of the compound having the formula VI.

15. The method of Claim 6, wherein the hydrogenation step is conducted under an atmosphere of hydrogen at from 0.5 to 200 atmospheres.

16. The method of Claim 6, wherein the hydrogenation step is conducted in a solvent comprising an aliphatic hydrocarbon, an aromatic hydrocarbon, a cyclic ether, an acyclic ether, a halogenated hydrocarbon, a dialkyl ketone, a polar aprotic solvent, or a combination thereof.

17. The method of Claim 6, wherein the hydrogenation step is conducted at from -20 °C to 100 °C.

18. A compound having the formula XI



XI

wherein R^1, R^3, and R^4 are, independently, hydrogen, a substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl group; a substituted or unsubstituted C_3 to C_8 cycloalkyl group; a substituted or unsubstituted C_6

to C_{20} aryl group; or substituted or unsubstituted C_4 to C_{20} heteroaryl group, and

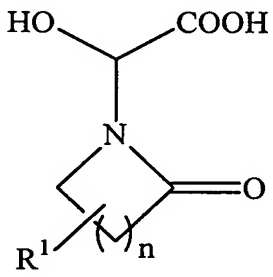
n is from 0 to 5.

19. The compound of Claim 18, wherein n is 2.

20. The compound of Claim 18, wherein R^1, R^3, and R^4 are hydrogen and n is 2.

21. The compound of Claim 18, wherein R^1 is hydrogen, R^3 and R^4 are methyl, and n is 2.

22. A method for producing a compound having the formula II,

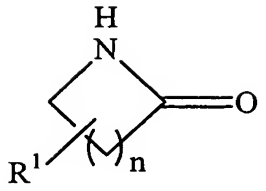


II

wherein R^1 is hydrogen, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl, and

n is from 0 to 5,

comprising reacting a compound having the formula I

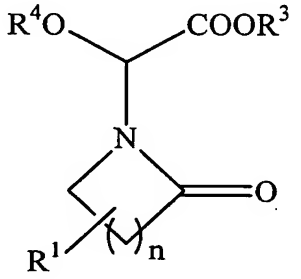


I

with glyoxylic acid.

23. The method of Claim 22, wherein the glyoxylic acid is present in the amount from 0.8 to 2 equivalents per 1.0 equivalent of the compound having the formula I.

24. A method for producing the compound having the formula III,

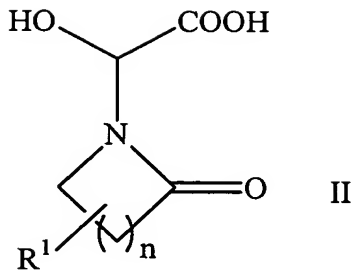


III

wherein R^1, R^3, and R^4 are, independently, a substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl group; a substituted or unsubstituted C_3 to C_8 cycloalkyl group; a substituted or unsubstituted C_6 to C_{20} aryl group; or a substituted or unsubstituted C_4 to C_{20} heteroaryl group, wherein R^1 can also be hydrogen, and

n is from 0 to 5,

comprising reacting the compound having formula II



II

with an alcohol comprising an alkyl alcohol, an aryl alcohol, or a heteroaryl alcohol, wherein the alkyl alcohol is substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl or substituted or unsubstituted C_3 to C_8 cycloalkyl; the aryl alcohol is substituted or unsubstituted C_6 to C_{20} aryl; and the heteroaryl alcohol is substituted or unsubstituted C_4 to C_{20} heteroaryl, wherein the heteroatom is oxygen, nitrogen, or sulfur.

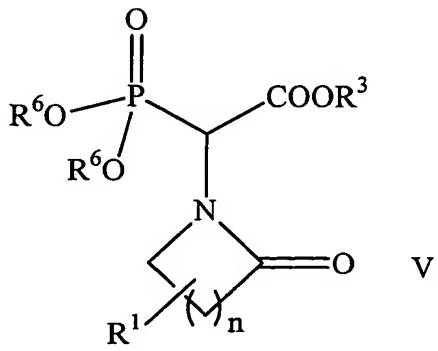
25. The method of Claim 24, wherein the alcohol is a C_1 to C_5 alcohol.

26. The method of Claim 24, wherein the alcohol is methanol or ethanol.

27. The method of Claim 24, wherein the alcohol is present in the amount from 2.0 to 5.0 equivalents per 1.0 equivalent of the compound having the formula II.

28. The method of Claim 24, further comprising a dehydrating agent.

29. A compound having the formula V



V

wherein R^1 and R^3 are, independently, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl, wherein R^1 can also be hydrogen,

R^6 is substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl or substituted or unsubstituted C_3 to C_8 cycloalkyl, and

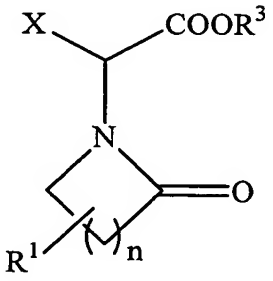
n is from 0 to 5.

30. The compound of Claim 29, wherein n is 2 and R^1 is hydrogen.

31. The compound of Claim 30, wherein R^3 is methyl or ethyl.

32. The compound of Claim 31, wherein R^6 is methyl or ethyl.

33. A method of producing the compound of Claim 29, comprising reacting a compound having the formula IV



IV

wherein R^1 and R^3 are, independently, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl, wherein R^1 can also be hydrogen,

X is fluoride, chloride, bromide, or iodide, and

n is from 0 to 5,

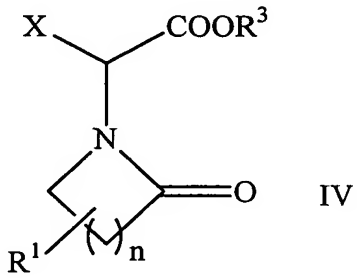
with a phosphite having the formula $P(OR^6)_3$, wherein R^6 is substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl or substituted or unsubstituted C_3 to C_8 cycloalkyl.

34. The method of Claim 33, wherein X is chloride or bromide.

35. The method of Claim 33, wherein R^6 is methyl or ethyl.

36. The method of Claim 33, wherein the phosphite is present in the amount from 0.8 to 1.2 equivalents per 1.0 equivalent of the compound having the formula IV.

37. A method of producing a compound having the formula IV,



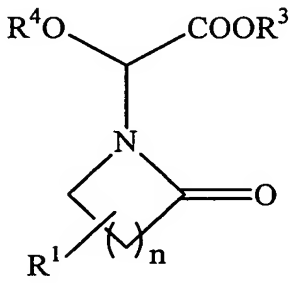
IV

wherein R^1 and R^3 are, independently, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl, wherein R^1 can also be hydrogen,

X is fluoride, chloride, bromide, or iodide, and

n is from 0 to 5,

comprising reacting a compound having the formula III



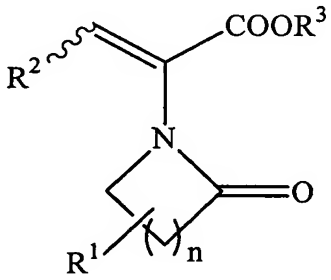
III

wherein R^1, R^3, and R^4 are, independently, a substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl group; a substituted or unsubstituted C_3 to C_8 cycloalkyl group; a substituted or unsubstituted C_6 to C_{20} aryl group; or a substituted or unsubstituted C_4 to C_{20} heteroaryl group, wherein R^1 can also be hydrogen, and

n is from 0 to 5,

with a compound having the formula PX_3, wherein X is fluoro, chloro, bromo, or iodo.

38. A compound having the formula VI



VI

wherein R^1, R^2, and R^3 are, independently, hydrogen, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or

unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl, and

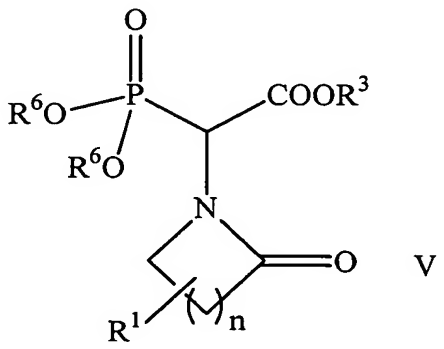
n is from 0 to 5.

39. The compound of Claim 38, wherein n is 2 and R^1 is hydrogen.

40. The compound of Claim 39, wherein R^2 and R^3 are methyl.

41. The compound of Claim 39, wherein R^2 is methyl and R^3 is ethyl.

42. A method for producing the compound of Claim 38, comprising reacting a compound having the formula V



V

wherein R^1 and R^3 are, independently, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl, wherein R^1 can be hydrogen,

R^6 is substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl or substituted or unsubstituted C_3 to C_8 cycloalkyl, and

n is from 0 to 5,

with an aldehyde having the formula $HC(O)R^2$, wherein R^2 is hydrogen, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl

in the presence of a base.

43. The method of Claim 42, wherein the base comprises an amidine base or a guanidine base.

44. The method of Claim 42, wherein the base comprises 1,5-diazabicyclo(4.3.0)non-5-ene; 1,8-diazabicyclo(5.4.0)undec-7-ene, or tetramethylguanidine.

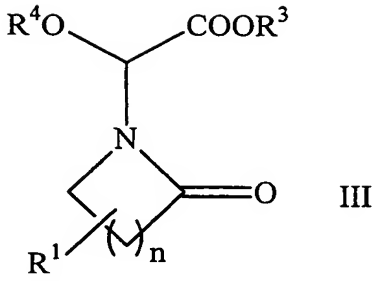
45. The method of Claim 42, wherein the base is present in the amount from 1.0 to 2.0 equivalents per 1.0 equivalent of the compound having the formula V.

46. The method of Claim 42, wherein the aldehyde is present in the amount from 0.8 to 1.5 equivalents per 1.0 equivalent of the compound having the formula V.

47. The method of Claim 42, wherein the aldehyde is acetaldehyde.

48. A method for producing the compound of Claim 38 *in situ*, comprising

(a) reacting a compound having the formula III



III

wherein R^3 and R^4 are, independently, hydrogen, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl group; substituted or unsubstituted C_3 to C_8 cycloalkyl group; substituted or unsubstituted C_6 to C_{20} aryl group; or substituted or unsubstituted C_4 to C_{20} heteroaryl group, wherein R^1 can also be hydrogen

with PX_3, wherein X is fluoride, chloride, bromide, or iodide, to produce a halogenated lactam;

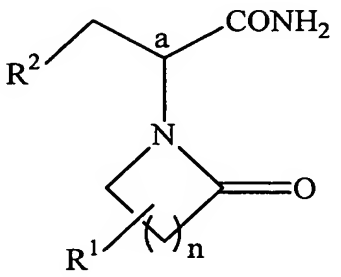
(b) reacting the halogenated lactam produced in step (a) with a phosphite having the formula $P(OR^6)_3$, wherein R^6 is substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl or substituted or unsubstituted C_3 to C_8 cycloalkyl, to produce a phosphonated lactam; and

(c) reacting the phosphonated lactam produced in step (b) with an aldehyde having the formula $HC(O)R^2$, wherein R^2 is hydrogen, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl,

in the presence of a base,

wherein steps (a), (b), and (c) are performed *in situ*.

49. A method for producing a compound having the formula VIII



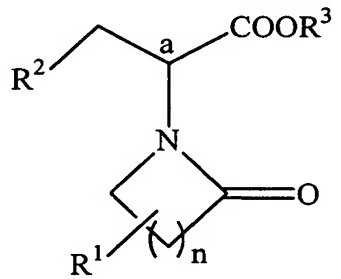
VIII

wherein R^1 and R^2 are, independently, hydrogen, substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl,

n is from 0 to 5, and

the stereochemistry at carbon a is substantially R or S,

comprising reacting a compound having the formula VII



VII

wherein R^3 is substituted or unsubstituted, branched or straight chain C_1 to C_{20} alkyl; substituted or unsubstituted C_3 to C_8 cycloalkyl; substituted or unsubstituted C_6 to C_{20} aryl; or substituted or unsubstituted C_4 to C_{20} heteroaryl,

with NH_4OH.

50. The method of Claim 49, wherein the NH_4OH is present in the amount from 1 to 10 equivalents per 1.0 equivalent of the compound having the formula VII.